INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(54) Title: METHOD IN A TELECOMMUNICATION SYSTEM

(57) Abstract

The present invention relates to a method for downlink power control in the base station of a code division multiple access (CDMA) communication system. The total assigned downlink power from the base station is adjusted to a maximum downlink power level by means of individually adjusting the assigned bit rates of an appropriately selected subset of downlink channels to those users having a data communication connection. Said subset is retrieved by applying suitable selection criterions for the downlink channel, e.g., the momentarily assigned bit rate, the reported pathloss, or the user subscription type.

METHOD IN A TELECOMMUNICATION SYSTEM

FIELD OF THE INVENTION

The present invention relates generally to methods in telecommunication systems, more particularly to methods for
5   downlink power control in the base station of a code division multiple access (CDMA) communication system.

BACKGROUND OF THE INVENTION

In code division multiple access (CDMA) communication
10   systems, a plurality of base stations cover each a certain geographic area and provide communication services to users within such areas. Characteristic for CDMA-systems is that the common transmission medium is shared between different users by assigning specific and unique code sequences to the
15   uplink and downlink channels between base station and user equipment. These code sequences are used by the transmitters to transform signals into wideband spread spectrum signals. In the receiver units, base station or user equipment, said wideband signals from a specific transmitter are
20   retransformed into the original bandwidth by using the same code sequence as that transmitter while signals marked with different codes remain wideband signals and, thus, are interpreted by the receiver as part of the background noise.

An aspect specific to the multiple access technique used in
25   CDMA relates to the fact that all users transmit wideband signals potentially at the same time and using the same bandwidth. Thus, one limiting factor in CDMA-based systems is a decreasing signal-noise ratio in the communication channels due to an increasing interference level caused by
30   other transmitters. Said signal interference level per cell results from transmitters within said cell as well as from transmitters in the neighbouring cells. From this it becomes

apparent that power control, both of uplink signals and
downlink signals, is crucial in order to achieve a maximised
system capacity and high quality of services. This implies
for the uplink signals that the transmission power of the
5   user equipment must be controlled, e.g., in order to avoid
that users close to their serving base station dominate
users at a longer distance and in order to allow an
optimised number of users within the limitations of the
acceptable interference level. For the downlink signals
10   power control is required, i.a, in order to minimize the
interference to other cells and, accordingly, to compensate
against interference from other cells. By this means, a base
station is able to serve users preferably at any location
within the cell and without a too strong contribution to the
15   interference level of the neighbouring cells. Yet another
important aspect for downlink power control relates to the
fact that increasing power values lead to a spreading of the
signal spectrum. Therefore, in order to avoid a spreading of
the total downlink signal spectrum outside the allowed
20   frequency range that is reserved for the downlink signals of
a CDMA-based communication system, the total allocated
downlink power for a base station must be limited to a
maximum power level.

As thus the downlink transmission power of a base station is
25   a limited resource there is a need for methods to allocate
appropriate power levels to the various downlink channels in
such a way that the total allocated power remains below said
maximum power level. One solution for said downlink power
control relates to a fixed allocation of a maximum downlink
30   power per user such that the sum of the allocated power
levels remains below the maximum threshold. This minimises
the risk that said maximum power level is exceeded but
results in poor system capacity due to a lack of
flexibility.

35

SUMMARY OF THE INVENTION

It is a first object of the present invention to achieve an efficient method for management of the downlink power resources of a base station.

5   It is another object of the present invention to achieve a method in a downlink power limited system for power allocation to each of the downlink channels of those users that have an established data connection such that the level of the allocated downlink power for the base station as a

10   whole remains below a permitted maximum downlink power level.

It is still another object of the present invention to achieve a method for allocation of said downlink power and for adjustment to an available downlink power level

15   individually for each of said downlink user data channels.

It is yet another object of the present invention to achieve a method that can limit the total allocated downlink power without degrading the transmission quality of the downlink user data channels.

20   Briefly, these and other objects of the present invention are accomplished by a method that periodically performs an estimation of the total allocated downlink power on basis of radio environmental parameters and the momentarily applied bit rate for the downlink user data channels. If said

25   allocated power exceeds a threshold given by the permitted maximum downlink power, the bit rate of user data channels to appropriately selected users are adjusted.

The invention is founded on the insight that the transmission power for each of the downlink user data

30   channels of a base station depends on the transmitted signal energy and the transmission bit rate. Thus, the allocated downlink transmission power can be controlled by adjusting

either said signal energy or, preferably, said transmission bit rate for a certain channel or group of channels.

As a first advantage, the present invention enables a base station to manage the allocated downlink power without exceeding the permitted maximum downlink transmission power.

It is another advantage of the present invention that said allocated downlink power can be adjusted in accordance with, e.g., individual user demands or network conditions and without degrading channel quality.

Yet another advantage of the present invention is an improved service coverage of users by means of a decreased dropped call rate. The allocated downlink power for the user data channels can be regulated in such a way that the number of users receiving a good service quality can be noticeably increased.

Thus, it is still another advantage of the present invention relates to optimized information throughput and/or system capacity.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding, reference is made to the following drawings and preferred embodiments of the invention.

Figure 1 shows an overview of a CDMA-based communication system and more particularly a cell including a plurality of user equipments that are served by a base station.

Figure 2 illustrates an embodiment of the method according
to the present invention. The allocated downlink power is
adjusted by means of adjusting the bit rates that are
assigned to the various downlink user data channels.

5   Figure 3 shows a flowchart of the method according to the
present invention.

DETAILED DESCRIPTION

10 Figure 1 shows an overview of a CDMA-based radio
communication system divided into a plurality of cells 11,
each of which equipped with a base station 12 for providing
communication services, e.g., speech or data connections,
to and from user equipments 13a-13d within the coverage
15 area of the base station 12. The present invention refers
to the downlink channels 14a-14d from the base station 12
to those of said user equipments 13a-13d that have an
established data connection. It relates in particular to
controlling and efficiently allocating power for said
20 downlink channels that are applied for said data
connections.

For a base station 12, the downlink power P_{out} that must be
allocated in order to serve a given number of user
equipments 13a-13d within its cell 11 can be expressed as

25
$$P_{out} = \sum_{i=1}^{N} P_{i,speech} + \sum_{i=1}^{M} P_{i,data} < P_{max} .$$

Here, the total allocated downlink power P_{out} is interpreted
as the sum of transmission powers P_i that are allocated to a
number N of downlink speech channels and a number M of
downlink user data channels. The allocated downlink power
30 P_{out} for both types of downlink channels must not exceed a
permitted maximum downlink power level P_{max} that is
conditioned by the undesired spectrum spreading as

described above. However, P_{max} can also be defined as a target power level below said critical value depending on the actual system load. By this means, the total permitted downlink power can be used in cases of a sufficiently high system capacity while said target value can be reduced at times with less traffic.

As speech connections must meet certain minimum requirements and, thus, allocate in advance a certain amount P_{speech} of the permitted downlink power P_{max}, the maximum available share of said permitted downlink power that remains for the downlink user data channels varies in dependence of the number N of downlink speech channels. Accordingly, the sum of downlink powers for each of the user data channels must be adjusted in order to remain below said maximum available share of the downlink power. Within the scope of the present invention, the allocated power $P_{i,data}$ per downlink user data channel is expressed by means of the transmitted signal energy per bit $E_{b,i}$ and the transmission bit rate R_i, i.e.

$$\sum_{i=1}^{M} P_{i,data} = \sum_{i=1}^{M} E_{b,i} \cdot R_i \ .$$

A first aspect of the present invention relates to the fact that the total allocated downlink power P_{out} of the base station 12 can be adjusted to said permitted maximum downlink power P_{max} preferably by means of individually adjusting the power levels $P_{i,data}$ for each of the downlink user data channels rather than determining static maximum downlink power levels for these channels. This implies that each of said downlink user data channels is adjusted according to its specific requirements for the amount of allocated power. Said requirements mainly depend on demands from the individual users 13a-13d and the given conditions of the radio environment for said channels. Other requirements may relate to the network utilization in

total, e.g. with respect to system capacity or information throughput.

The impact of the individual user of a data connection relates in general to the subscription type, e.g., with
5   respect to disposable services or guaranteed service quality, and more specific to the actually demanded service, e.g., with respect to required bandwidth or user activity. Environmental parameters that must be taken into consideration with respect to radio propagation conditions
10 are, e.g., general terrain characteristics and different kinds of obstacles, e.g. trees 15 or buildings 16, that influence the radio channel. Due to an increased mobility of certain users 13b said environmental parameters can change rapidly and must be adjusted accordingly fast. Other
15 impacts result from the total signal interference level due to environmental noise or transmissions from other users within the cell. In addition, especially at the cell borders, a user equipment 13d may also be influenced by signal interference from, e.g., base stations 17a,17b or
20 users 18 in neighbouring cells while the quality of the downlink channel from the serving base station may decrease. Thus, by means of said first aspect of the method according to the present invention it is possible to dedicate the maximum available share of the downlink power
25 that can be used for data traffic individually to the downlink user data channels within the limitations of the permitted downlink power P_{max} while still being able to meet in a flexible way the varying requirements as described above.

30 A second aspect of the present invention relates to the fact that said allocated power $P_{i,data}$ per downlink user data channel can principally be adjusted by using two different alternatives: One alternative is to adjust the power level by varying the transmitted signal bit energy $E_{b,i}$ of one or
35 more of said downlink channels. However, as decreasing

power values result in a lower quality of the radio channel
due to a decreasing signal-to-interference ratio E_b/I_o, this
alternative may result in a decreasing information
throughput, due to a possibly increasing number of frame
5   errors and packet retransmissions. Additionally, due to the
insufficient signal power level that is received by some of
the user equipments, the call drop rate can increase,
especially at the cell borders. Another alternative, which
is preferred according to the present invention, is to
10   adjust the transmission bit rate R_i for one or more of said
downlink user data channels while the signal power is kept
at a level that is sufficiently high to maintain a given
target signal-to-interference ratio E_b/I_o. For decreasing
bit rates, this alternative also results in a decreasing
15   information throughput; however, as the transmission bit
rate can be adjusted according to the actual needs of the
individual users while the transmission error rate remains
unchanged, this solution is more convenient and causes,
e.g., less extra signalling.

20   Figure 2 presents in a first diagram the total allocated
downlink power P_{out} of a base station as a function of time.
Said allocated downlink power is composed of shares for the
downlink power allocated to all speech connections, P_{speech},
and for the downlink power allocated to all data
25   connections, P_{data}. In compliance with the first aspect of
the invention, the method according to the invention is
intended to control the total allocated downlink power P_{out}
by individually adjusting the power levels of the downlink
user data channels within the range of the maximum
30   available power that can be used for data traffic. This is
done by means of estimating the allocated downlink power
P_{out} for an initial setting of the bit rates of said data
channels and controlling said power at certain times t_i. If
necessary, said bit rates are adjusted in an iterative
35   procedure in compliance with the second aspect of the

invention. If said total allocated downlink power P_{out}
exceeds the permitted maximum downlink power level P_{max} by a
certain amount 211, as shown for time interval $[t_i, t_{i+1}]$,
said adjustment for the downlink user data channels implies
5   a limitation to the threshold level P_{max}. Correspondingly,
as long as the allocated downlink power remains below said
permitted downlink power level P_{max} by a certain amount 221,
as shown for time interval $[t_j, t_{j+1}]$, the remaining power may
be allocated in addition to the downlink user data
10   channels. Thus, yet another aspect of the present invention
relates to approaches for selection of appropriate downlink
user data channels that are to be adjusted in order to
achieve an optimized allocation of the maximum available
downlink power resources. Selection criterions relate to
15 · user demands, radio environmental conditions, and network .
maintenance as described above. In the example as shown in
diagrams 212 and 222, the applied selection criterion is
the bit rate (BR) that is assigned to the downlink user
data channels [1,M]. If P_{out} is larger than P_{max}, the diagram
20   212 indicates that the assigned bit rate is reduced to a
maximum bit rate (BR_{max}) for those downlink user data
channels that exceed said maximum value. If P_{out} is less
than P_{max}, the diagram 222 indicates that the assigned bit
rate is increased to a maximum bit rate (BR_{max}) for those
25   downlink user data channels that are below said maximum
value. Other suitable selection criterions will be
described in the following. The selection of bit rates for
the various downlink user data channels in a cell is
performed at certain times, e.g. every 10ms, preferably
30   with larger periods than the reporting intervals of the
systems power control for uplink and downlink channels.

Figure 3 shows a flowchart representing the various steps
of the method according to the present invention.
Initially, block 31, before starting the method according
35   to the present invention some radio environmental

parameters need to be calculated for each downlink user
data channel in order to be able to perform the bit rate
selection for said channels. In order to keep track on the
momentary transmission quality, pathloss and signal-to-

5   interference ratio must be determined for each downlink
user data channel. The pathloss corresponds to the signal
attenuation due to the distance of a user equipment to its
serving base station. This value is calculated from the
downlink signal strength that is reported by the user

10   equipment of that downlink channel. The signal-to-
interference ratio (E_b/I_0 target) is calculated in the
downlink outer loop power control, which is located either
in the network or in the user equipment. Said downlink
power control regulates the signal bit energy of the

15   downlink channels to a sufficiently high target value in
response to the ratio values for the uplink channel
indicated by the user equipment. These values are updated
by the system within much shorter time periods than the
decision time periods for bit rate selection. Therefore, it

20   can be assumed that said method always applies actually
valid values. Other parameters that influence the radio
channel are, e.g., external noise, which may be assumed as
white Gaussian noise with constant spectral density N, and
a correlation factor, which describes the correlation

25   between different channels due to an imperfect
orthogonality of the applied downlink spreading codes.
These values may be considered as constant with respect to
the method according to the present invention.

In a next step, block 32, an initial bit rate is assigned

30   to each downlink user data channel. For those channels that
have something to send, this is, e.g., the highest possible
bit rate. Channels having no data to send choose the lowest
possible bit rate that is sufficient to keep the downlink
power control running. Hereby, the output traffic from a

35   base station to all downlink user data channels in a

subsequent time period can be estimated by cyclically checking the output transmission buffers for each of said downlink channels.

Then, block 33, from these initial settings, a preliminary
5   value for the allocated downlink power is estimated.

Said value for the allocated downlink power P_{out} is compared with the permitted maximum downlink power level P_{max}, block 34. As long as the allocated power is less than said permitted power level, the system is presently not downlink
10 power limited.

However, if said estimated value for the power demand is higher than the permitted downlink power, the system need to adjust the bit rates for one or more of the downlink user data channels to a lower bit rate. This is achieved in
15 an iterative procedure by the steps of selecting a subset of downlink user data channels, block 351, and reselecting the bit rates of these channels, block 352. From these reselected bit rates, an adjusted value is estimated for the total allocated downlink power P_{out}, block 353, and said
20 iterative procedure is repeated as long as P_{out} exceeds the permitted maximum downlink power P_{max}. Said selection can be done according to certain selection criterions and is described in the following approaches that can be used alone or in combination.

25 Correspondingly, the method according to the present invention can also be applied when the allocated downlink power P_{out} remains below the threshold given by the permitted maximum downlink power P_{max}. Then, the remaining downlink power can be used in order to improve throughput,
30 i.e. an improved service quality by means of an increased bit rate for all or a certain subset of downlink user data channels. This is done by means of an iterative reselection procedure as described above including the steps of

selecting a subset of downlink user data channels, block 361, and reselecting the bit rates of said subset to a higher bit rate, block 362. From the reselected bit rates, an adjusted value is estimated for the total allocated

5   downlink power P_{out}, block 363, and said iterative procedure is repeated as long as P_{out} not exceeds the downlink power target value, block 364.

In a first approach, each of the downlink user data channels is treated equally with respect to the assigned

10   downlink bit rate per channel. Thus, in cases where the allocated downlink power exceeds the threshold value given by the permitted maximum downlink power, said allocated downlink power is adjusted by means of modifying the transmission characteristics of an appropriate subset of

15   downlink user data channels or, alternatively, of all downlink user data channels. Said appropriate subset may be retrieved by randomly selecting a number of downlink user data channels. In another alternative, a subset is retrieved by cyclically selecting a subset of index values

20   representing starting positions in the downlink transmission buffer for data to be sent on a downlink user data channels. By this means, within certain time periods each of said downlink user data channels has a momentarily decreased bit rate. From the base stations point of view,

25   this approach is easy to implement and to maintain; however, it disregards the fact that the downlink channels to users at various locations in the cell have differing preconditions with respect to their downlink power need. Correspondingly, a first approach in cases where the

30   allocated downlink power level is below the permitted maximum downlink power level is to increase the bit rate equally for each of the active downlink user data channels. However, this implies only a small increase for each of the individual users.

Thus, another approach to select a subset of downlink user data channels relates to the physical properties of said downlink channels as selection criterion, e.g., with respect to the reported pathloss, the needed power level

5   for said downlink channels, or the momentarily assigned bit rate. In case of a necessary reduction of the allocated downlink power, this implies that channels with unacceptable high pathlosses, e.g., at the cell borders, are treated with a lower priority because this relatively

10   small number of users consumes a considerable part of the available downlink power in disadvantage to a plurality of other users. Alternatively, at first those channels are selected having the highest assigned bit rates and then pathloss and/or needed power level might be taken into

15   consideration. Thus, from the systems point of view, this approach intends to optimize the number of those downlink user data channels to which the base station is able to provide a good downlink channel quality with respect to, e.g., bit rate and pathloss rather than just maximizing the

20   number of supported users. However, for those users that consume too much of the total downlink power the method according to the present invention can indicate the necessity of an alternative treatment. When regarding, e.g., users at the cell borders of a heavy-loaded cell,

25   said method could initiate a handover to a neighbouring cell with less traffic. Correspondingly, if the bit rates are reselected towards a higher bit rate, preferably those downlink channels are selected that already have a good channel quality in order to noticeably increase service

30   quality for these users.

Yet another approach may relate to the user's subscription type, e.g., a prime subscription type guaranteeing at least a certain minimum bit rate at any condition or a low-budget type without any guarantees in point of access or bit rate.

35   Additional user related selection criterions are, e.g.,

packet arrival time or packet waiting time in order to be able to observe the individual user needs in a better way. This implies that the status of the transmission buffers of the various downlink user data channel is applied as a
5   selection criterion. Thus, users that momentarily request a large amount of data can be assigned a higher bit rate in order to fulfil their momentary need as good as possible and in order to avoid an overflow of the base station's output transmission buffer. Correspondingly, by means of
10   these selection criterions it is avoided that certain users are disregarded over a longer time period.

15

CLAIMS

1. Method in a telecommunication system comprising a plurality of base stations, each of which providing communication services to a selected number of user equipments by means of allocated downlink channels, whereof data communication services are provided to a part of said user equipments by means of downlink user data channels having an assigned initial bit rate,

characterised in

performing in each base station at regular time intervals the steps of

estimating the total allocated downlink power from all downlink channels of a base station,

selecting all or a subset of downlink user data channels to momentarily active users if said total allocated downlink power differs from a permitted maximum downlink power level of a base station,

adjusting the total allocated downlink power to the permitted maximum downlink power level by means of adjusting the bit rate for said selected downlink user data channels.

2. Method according to claim 1,

characterized in

selecting all or a subset of downlink user data channels if said total allocated downlink power exceeds said permitted maximum downlink power level of a base station,

adjusting the selected downlink user data channels by means of assigning a lower bit rate.

3. Method according to claim 2,

c h a r a c t e r i z e d   i n

selecting a subset of downlink user data channels by means of selecting an appropriate number from amongst the downlink user data channels having an assigned bit rate that exceeds a threshold value.

4. Method according to claim 2,

c h a r a c t e r i z e d   i n

selecting a subset of downlink user data channels by means of selecting an appropriate number from amongst the downlink user data channels having a pathloss that exceeds a threshold value.

5. Method according to claim 2,

c h a r a c t e r i z e d   i n

selecting a subset of downlink user data channels by means of selecting an appropriate number from amongst the downlink user data channels to those users without a prime-rate subscription type.

6. Method according to claim 1,

c h a r a c t e r i z e d   i n

selecting all or a subset of downlink user data channels if said total allocated downlink power is lower than said permitted maximum downlink power level of a base station,

adjusting the selected downlink user data channels by means of assigning a higher bit rate.

7. Method according to claim 6,

c h a r a c t e r i z e d   i n

selecting a subset of downlink user data channels by means of selecting an appropriate number from amongst the downlink user data channels having an assigned bit rate that is lower than a threshold value.

5   8. Method according to claim 6,

c h a r a c t e r i z e d   i n

selecting a subset of downlink user data channels by means of selecting an appropriate number from amongst the downlink user data channels having a pathloss that is lower than a
10 threshold value.

9. Method according to claim 6,

c h a r a c t e r i z e d   i n

selecting a subset of downlink user data channels by means of selecting an appropriate number principally from amongst
15 the downlink user data channels to those users having a prime-rate subscription type.

10. Method according to claim 2 or 6,

c h a r a c t e r i z e d   i n

selecting a subset of downlink user data channels by means
20 of cyclically selecting an appropriate range from index values indicating the starting positions of the downlink transmission buffers for said downlink user data channels.

11. Method according to claim 2 or 6,

c h a r a c t e r i z e d   i n

25 selecting a subset of downlink user data channels by means of randomly selecting an appropriate number of downlink user data channels.

12. Method according to one of the preceding claims,

c h a r a c t e r i z e d i n

selecting a subset of downlink user data channels by means of successively performing a selection of an appropriate number from amongst the downlink user data channels by

5   successively applying more than one selection criterion.

13. Method according to one of the preceding claims,

c h a r a c t e r i z e d i n

performing said method at regular time intervals that are considerably longer than the reporting intervals for radio

10   channel parameters from the user equipments.

14. Method according to claim 4,

c h a r a c t e r i z e d i n

initiating a handover to a neighbouring cell for a user equipment having the highest pathloss.

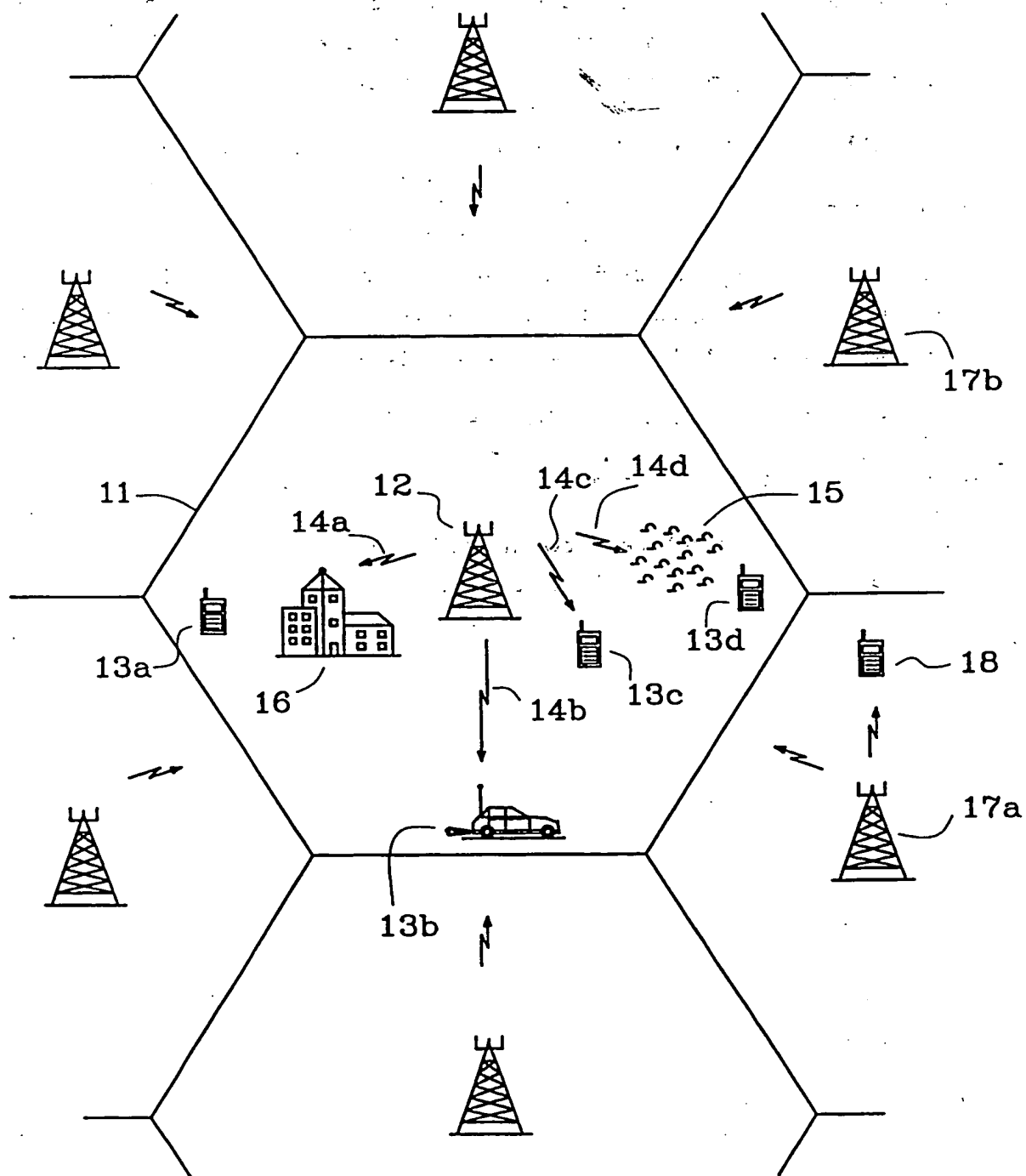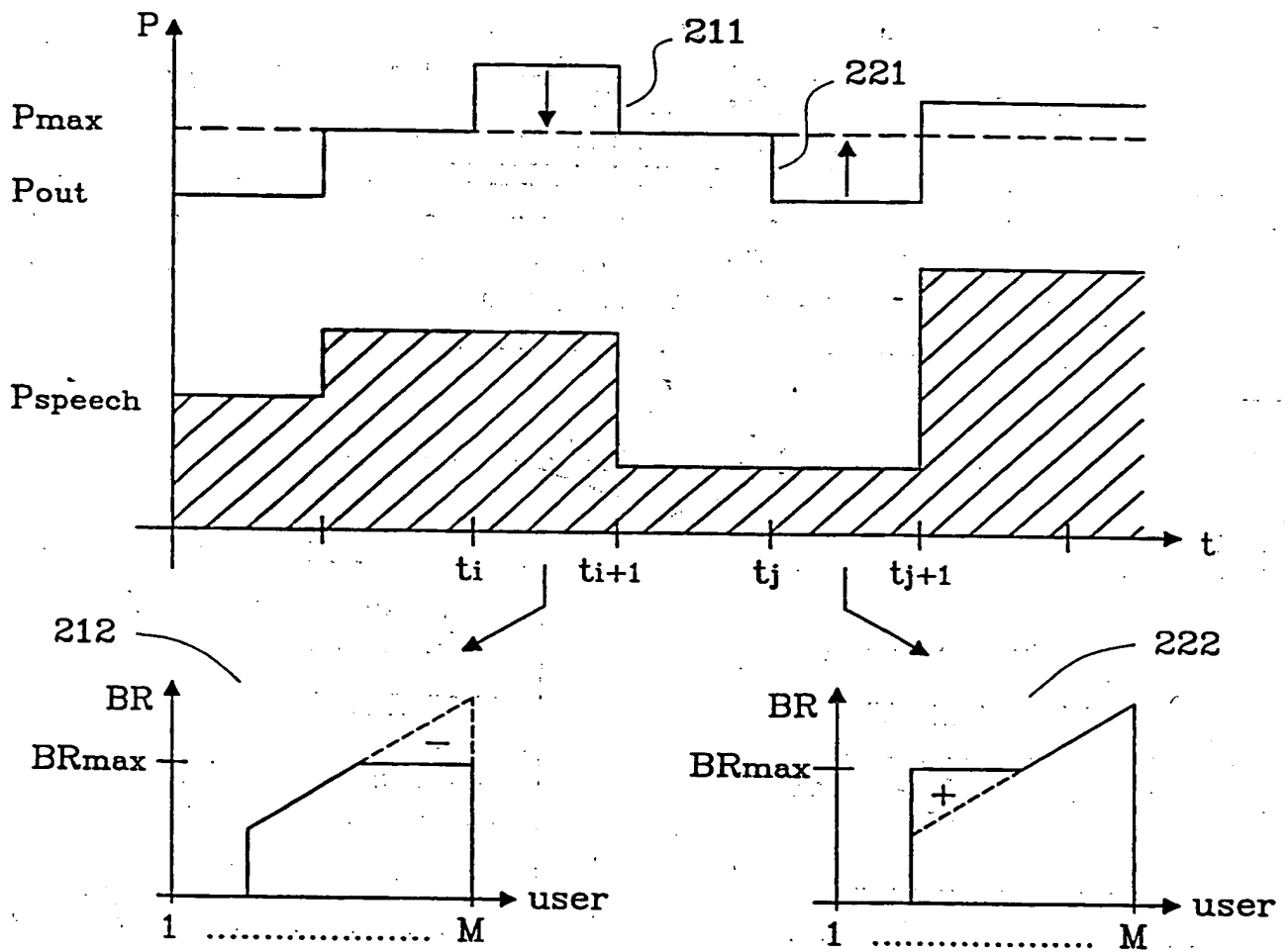Fig. 1

2/3

Fig. 2
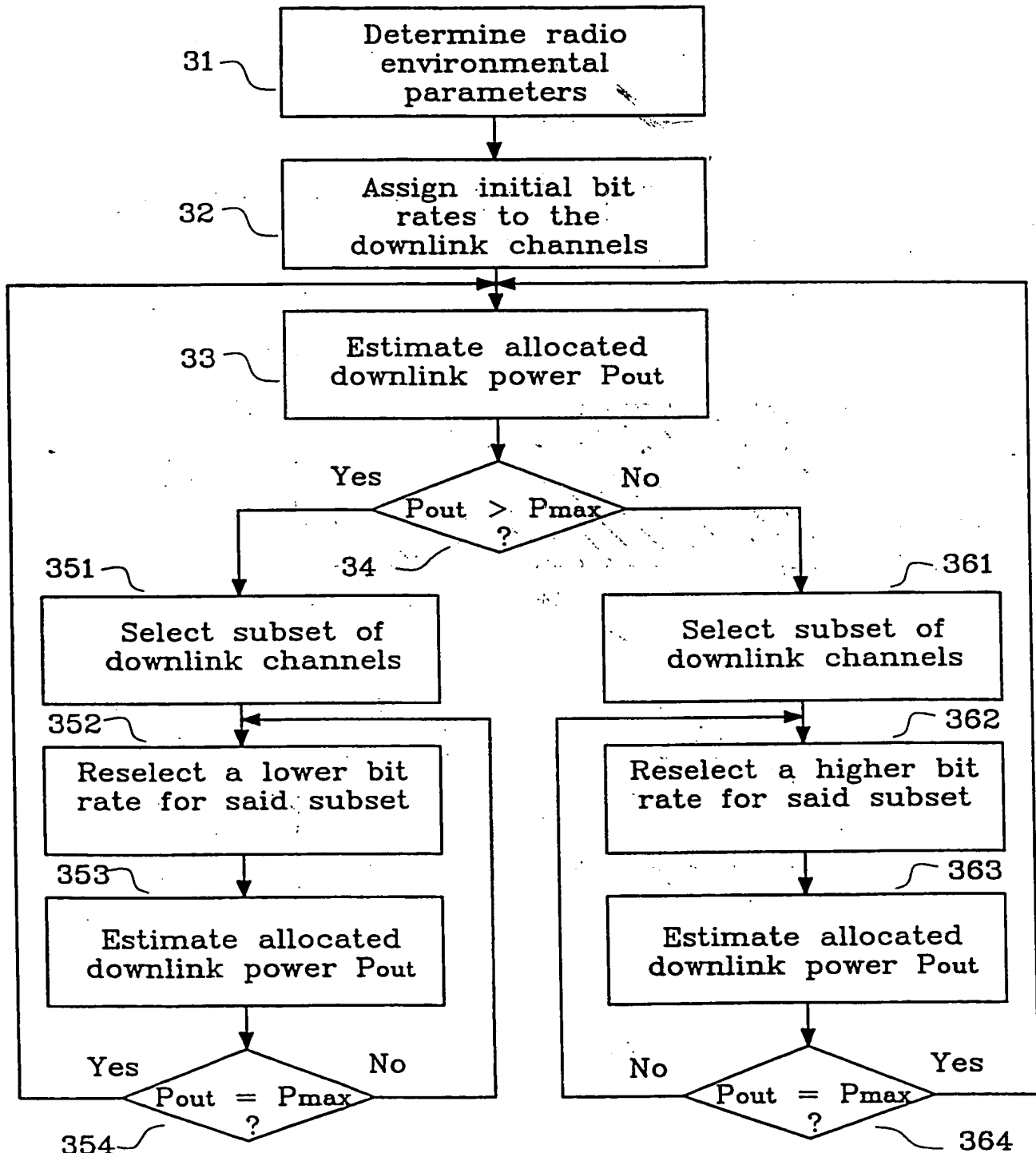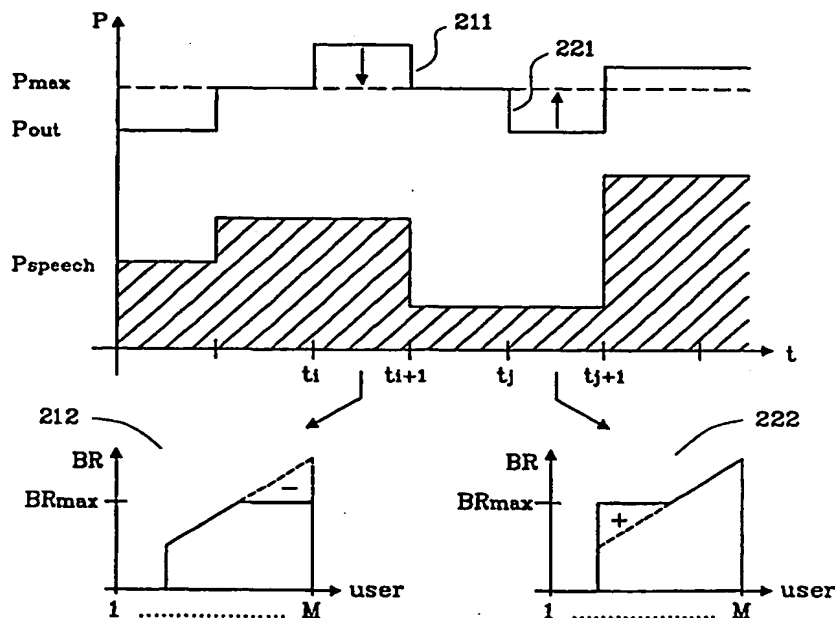
3/3

```
        ┌─────────────────────────┐
        │   Determine radio        │
  31 ───│   environmental          │
        │   parameters             │
        └─────────────────────────┘
                    │
                    ▼
        ┌─────────────────────────┐
        │   Assign initial bit     │
  32 ───│   rates to the           │
        │   downlink channels      │
        └─────────────────────────┘
```

```
        ┌─────────────────────────┐
        │   Estimate allocated     │
  33 ───│   downlink power Pout    │
        └─────────────────────────┘
                    │
          Yes       ▼        No
        ◄──── < Pout > Pmax > ────►
              <      ?      >
                    34
```

```
351 ──┐                              ┌── 361
┌─────────────────────┐      ┌─────────────────────┐
│  Select subset of   │      │  Select subset of   │
│  downlink channels  │      │  downlink channels  │
└─────────────────────┘      └─────────────────────┘
352 ──┐      │                        │      ┌── 362
       ▼                              ▼
┌─────────────────────┐      ┌─────────────────────┐
│  Reselect a lower bit│     │  Reselect a higher bit│
│  rate for said subset│     │  rate for said subset │
└─────────────────────┘      └─────────────────────┘
353 ──┐      │                        │      ┌── 363
       ▼                              ▼
┌─────────────────────┐      ┌─────────────────────┐
│  Estimate allocated │      │  Estimate allocated │
│  downlink power Pout │     │  downlink power Pout │
└─────────────────────┘      └─────────────────────┘
        │                              │
  Yes   ▼    No              No        ▼   Yes
  ◄── <Pout = Pmax> ──►      ◄── <Pout = Pmax> ──►
        <   ?   >                    <   ?   >
 354 ─┘                                  └── 364
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Fig. 3

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(54) Title: METHOD IN A TELECOMMUNICATION SYSTEM

(57) Abstract

The present invention relates to a method for downlink power control in the base station of a code division multiple access (CDMA) communication system. The total assigned downlink power from the base station is adjusted to a maximum downlink power level by means of individually adjusting the assigned bit rates of an appropriately selected subset of downlink channels to those users having a data communication connection. Said subset is retrieved by applying suitable selection criterions for the downlink channel, e.g., the momentarily assigned bit rate, the reported pathloss, or the user subscription type.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 99/02358

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04B 7/005

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0682418 A2 (NTT MOBILE COMMUNICATIONS NETWORK INC.), 15 November 1995 (15.11.95), column 3, line 39 - column 6, line 19, figure 10	1-14
A	WO 9849785 A1 (QUALCOMM INCORPORATED), 5 November 1998 (05.11.98), page 17, line 34 - page 21, line 28	1-14
A	WO 9737457 A1 (ADICOM WIRELESS, INC.), 9 October 1997 (09.10.97), page 13, line 13 - page 14, line 25	1-14

[X] Further documents are listed in the continuation of Box C.   [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
9 June 2000	1 3 -06- 2000

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INTERNATIONAL SEARCH REPORT

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